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Forest Service

Forestry Research West

July 1997

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A report for land managers on recent developments in forestry research at the four western Experiment Stations of the Forest Service, U.S. Department of Agriculture.

Forestry Research West

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Cover

The native Colorado River cutthroat trout is facing an upstream battle to maintain its populations. Here, an electrofishing crew is part of a study to learn more about the fish and its habitats. Read about it on page 13.

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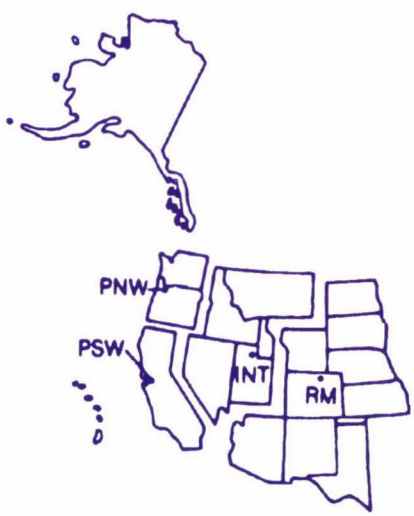
Western Forest Experiment Stations

Pacific Northwest Research Station (PNW)
333 S.W. First Avenue
Portland, Oregon 97204

Pacific Southwest Research Station (PSW)
P.O. Box 245
Berkeley, California 94701

Intermountain Research Station (INT)
324 25th Street
Ogden, Utah 84401

Rocky Mountain Forest and Range Experiment Station (RM)
240 West Prospect Street
Fort Collins, Colorado 80526-2098



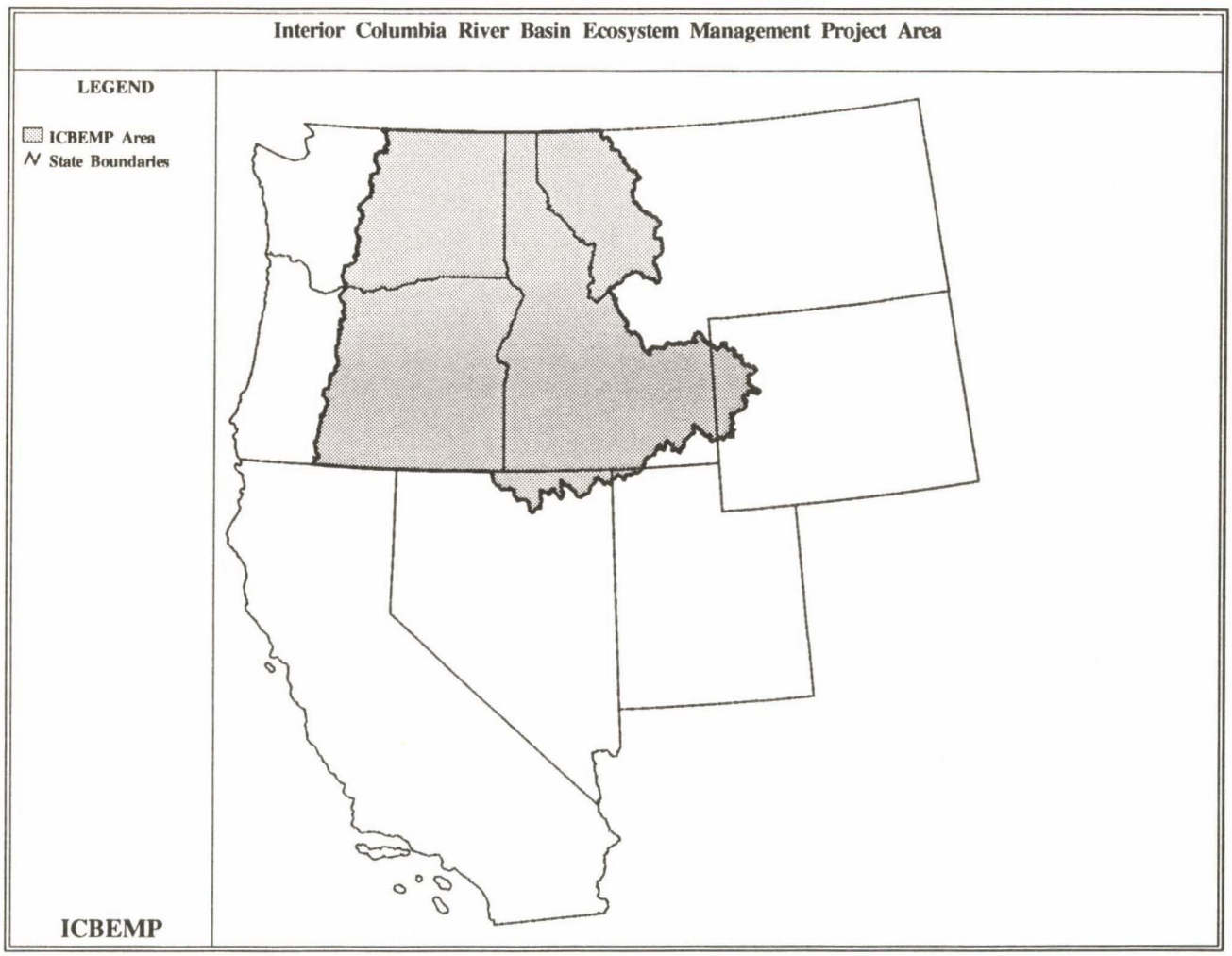
Understanding the Big Picture: The Interior Columbia Basin Ecosystem Management Project

By Heidi Bigler Cole and Thomas M. Quigley for the Pacific Northwest and Intermountain Research Stations

The challenge

Today's Forest Service and Bureau of Land Management (BLM) managers have challenges that their predecessors could not have imagined:

* Wildfires of unprecedented intensity and size are sweeping through the country on a regular basis.
* Damaging noxious weeds are changing the rangelands, leaving less habitat for wildlife and forage for livestock.
* Rural communities can no longer depend on a predictable flow of natural resources from public lands.



The 145 million-acre project area encompasses parts of seven states. The management strategy will affect 75 million acres managed by the Forest Service and BLM.

* Salmon populations are declining, and some species are nearing extinction.

Land managers know the problems are too big to tackle on a local basis. If local administrative units developed a coordinated strategy, however, their combined efforts would create an impact.

The Project

A 1993 presidential directive launched the Interior Columbia Basin Ecosystem Management Project. Several Federal agencies teamed up to develop an ecologically sound, scientifically based strategy for 75 million acres of land administered by the BLM and Forest Service.

The project sought to answer two questions: 1) What are the ecological and socioeconomic trends and conditions in the basin? and 2) What land management strategy would most effectively improve them? A team of scientists tackled the first question, and a management team tackled the second.

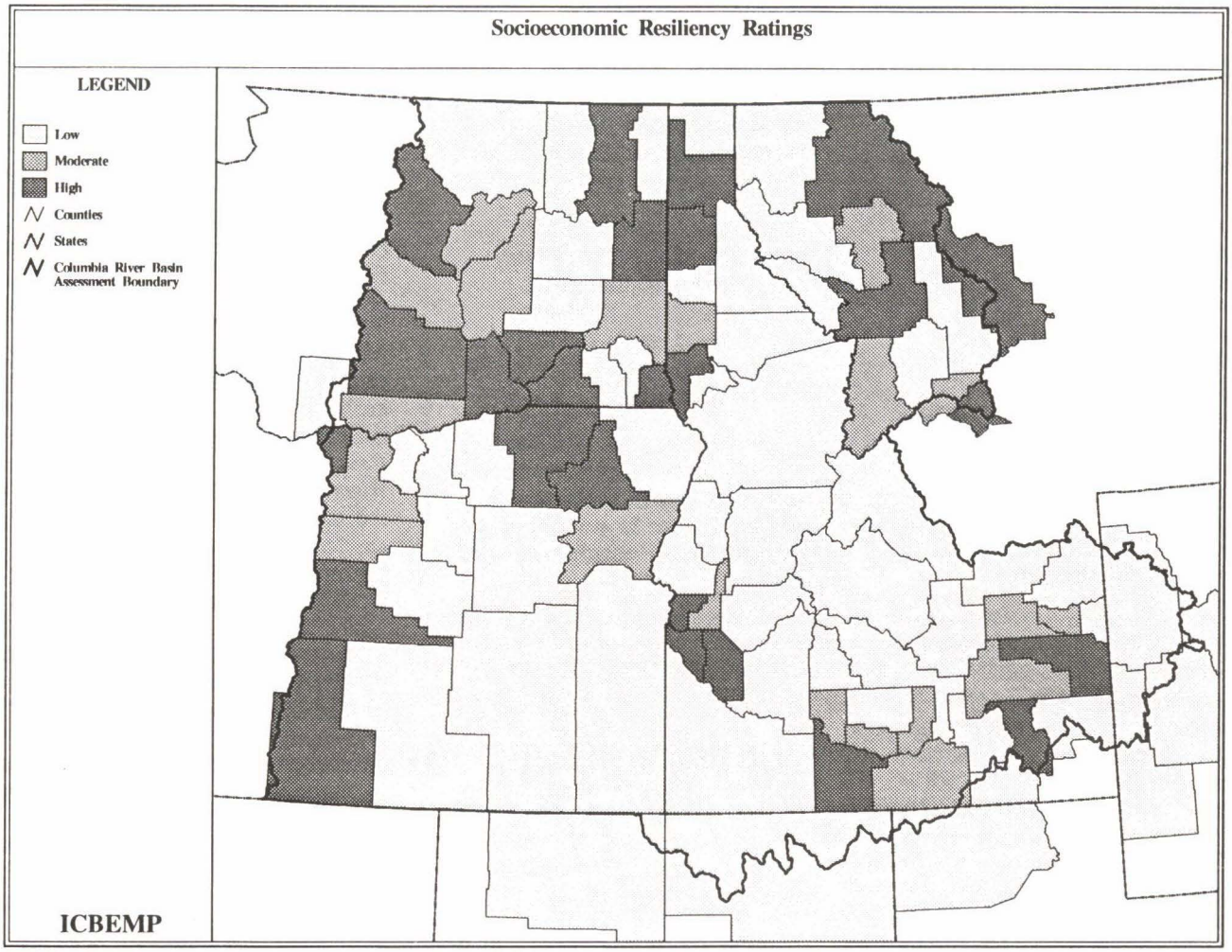
Land managers are using the science information to develop management strategies. These strategies are outlined and analyzed in two draft environmental impact statements (EISs), which will be released to the public late this spring. These documents will eventually amend 74 Forest Service and BLM plans, thereby enabling local units to implement a comprehensive, collaborative strategy that will address the broad-scale issues.

Scientists are providing credible information to managers on several management options as well as their risks, opportunities, and consequences. Managers will base decisions on science information. Scientists will not make decisions.

The science

A Science Integration Team formed to tackle the first question. The team included hundreds of scientists and technical specialists from Federal agencies and the larger science community. Their task was momentous: find a way to gauge the ecological and socioeconomic health for 145 million acres, an area the size of France. A scientific assessment of this size had never before been initiated in the United States. At the time it was conducted, it was the largest assessment of its kind in the world.

Some data needed to conduct the assessment had already been gathered; however, the data were scattered and inconsistent. After existing and new data were gathered, over 170 layers of information were analyzed using geographic information systems (GISs).



Counties high in socioeconomic resiliency are better able to withstand economic and social change.

Developing a meaningful interpretation of the science information required scientists to develop integrated measures. These measures are especially useful to managers, because they enable conditions, risks, and opportunities to be characterized across the landscape. The integrated measures they used are socioeconomic resiliency and ecological integrity.

Socioeconomic resiliency estimates the social and economic sensitivity to outside economic influences of a geographical area.. For example, a county with high socioeconomic resiliency is better equipped to handle new, nontraditional businesses or cope when a major business closes.

Ecological integrity describes the wholeness and resiliency of an ecological system. A system with high integrity functions properly because it has all its parts and processes intact. Such a system rebounds faster after wildfires, floods, road building, and other disturbances.

A significant event occurred once the data and GIS layers were analyzed. For the first time, scientists and managers could see the "big picture" stories being played out across the landscape. They could assess the risks and opportunities associated with alternative management strategies. Ecological integrity and socioeconomic resilience are but two measures that helped explain these "big picture" stories.

The findings

All science findings and the analysis behind them were subjected to a double blind peer review, which increased the soundness of the science.

Conclusions drawn from the scientific assessment both revealed surprises and confirmed hypotheses. Scientists conveyed the following general findings to the managers:

1) **Successful management strategies must simultaneously recognize and manage the multiple risks to ecological integrity and economic well being.**

Risks range from naturally caused wildfires and floods to human-caused events, including erosion from road building and disturbance from logging and domestic grazing. These different risks exist under any management strategy, and they interact, one affecting the magnitude of the other.

For example, targeted timber harvest and prescribed burns can reduce the risk of wildfire, but they pose their own direct risks to ecological integrity. Any strategy that focuses on the management of only one risk while ignoring the others is certain to generate significant detrimental ecological and economic effects.

Ecosystem management must encompass the specific actions being proposed and the ecological consequences and outcomes associated with inaction. Both action and inaction result in changed environments.

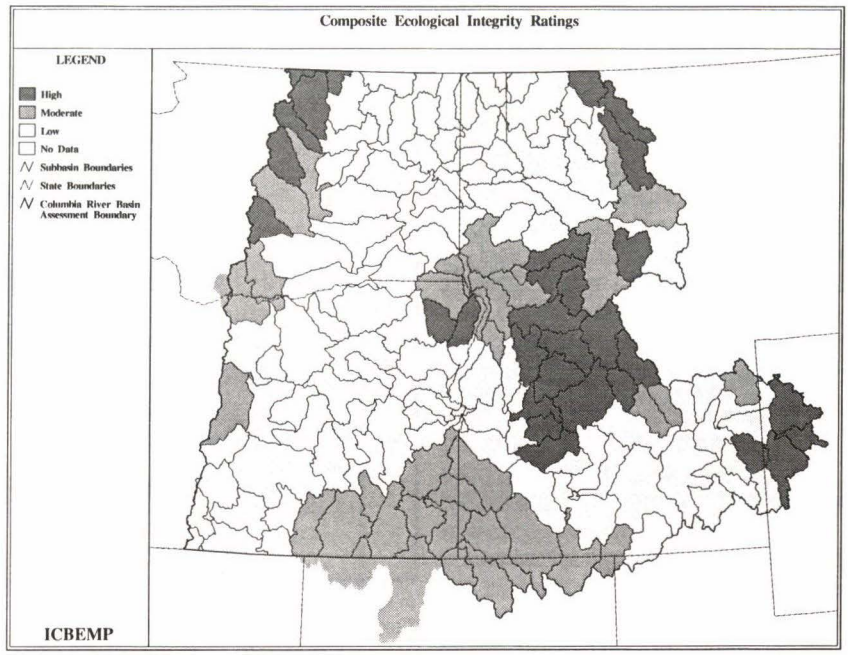
2) **Ecosystem management strategies should recognize that risks and opportunities differ significantly across the project area.**

The varied landscape of the area has a multitude of conditions and capabilities Any landscape strategy that dictates a "one-size-fits-all" prescription will not take advantage of this reality and will be less successful than a strategy that recognizes and takes advantage of this variability across the landscape.

3) Successful management strategies recognize that individual sites are linked to landscapes, and landscapes are linked to ecological processes and human activities.

Neither a landscape approach nor a site-specific approach alone can be successful. Ecosystem management must consider the site, the landscape, and their interactions simultaneously. In this multiple-scale approach, cumulative effects will be managed through the identification and management of risks and opportunities.

Specific science findings include the following:



Ecological integrity was ranked on a relative scale. An area with high ecological integrity has most of its functions and processes intact. An area with a low integrity rating may still have many functions and processes; its integrity level is low compared to the other areas.

Ecological integrity

Compared to many ecosystems in the world, lands within the project area administered by the Forest Service and BLM have much of their ecological integrity intact. Ecological integrity was rated as high, moderate, or low on a relative scale. Fifty-four percent of these lands have high or moderate integrity ratings. In general, the more a system has changed from natural conditions, the lower its integrity. A low-integrity area may not be totally degraded; its integrity is low compared to other lands in the project area. Low integrity should not necessarily be seen as "bad." Many low-integrity areas are filling societal needs.

Landscape

Fire

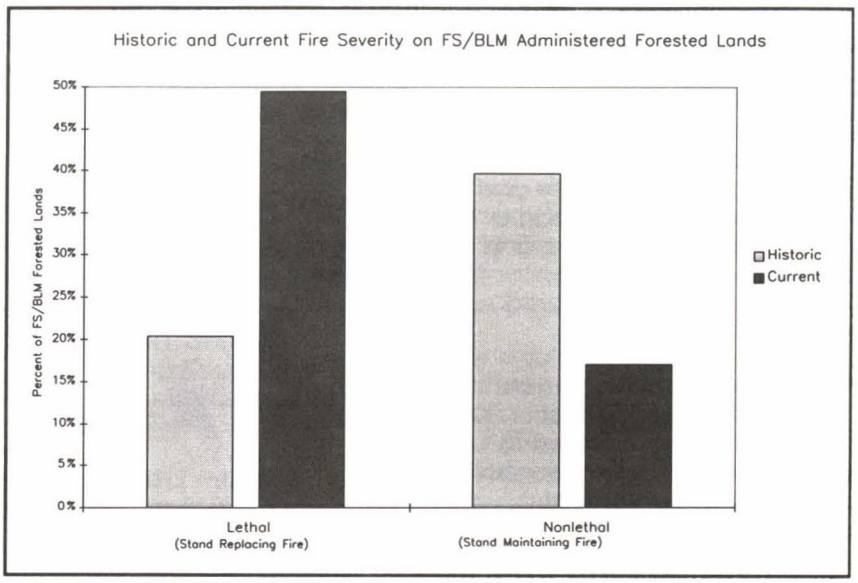
Severe, stand-replacement wildfires have increased from about 20 percent to nearly 50 percent in Forest Service and BLM-administered lands. This poses a significant threat to ecological integrity, water quality, species recovery, and homes in rural areas.

Forest

Species mix and age classes have changed within the project area. Historically, there were more old-and mixed-aged class stands. Now, uniform stands of middle-aged trees predominate. Small-diameter trees make up much of the current timber volume.

Range

Scientists understood that noxious weeds were a problem in the project area; however, they were surprised that rangelands were so extensively predisposed to weed invasion. Drought, fire suppression, and overgrazing have made rangelands more susceptible to noxious weeds.



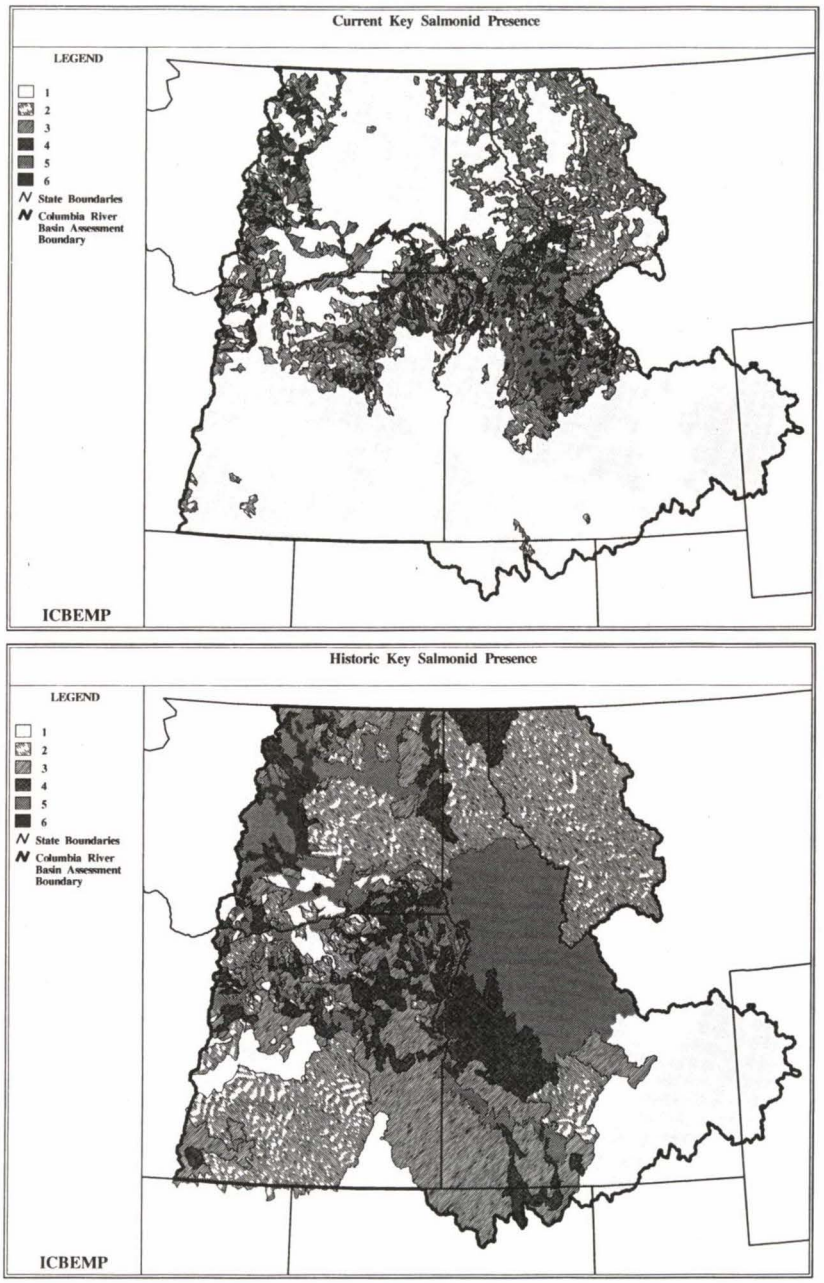
In recent times, the acreage burned by lethal fires has more than doubled. Before European settlement, low-intensity, nonlethal fires burned over a larger area.

Aquatics

The basin has experienced widespread and dramatic change in the composition, structure, and distribution of fish communities. These changes include widespread introduction of nonnative species (for example, brown trout, crappie) and endemic species extinction (for example, Alvord cutthroat and Miller Lake Lamprey). Salmonid species currently occupy a small portion of their historic range. Strong populations inhabit an even smaller area. Depending on the species, strong salmonid populations inhabit less than 33 percent of their currently occupied range.

Much of the native ecosystem has been altered, but core areas remain for rebuilding and maintaining functioning native aquatic systems.

Salmonid habitat protection and restoration alone will not ensure future healthy populations . The effects of dams, hatcheries, fish harvest, and introduced fish species also must be addressed.

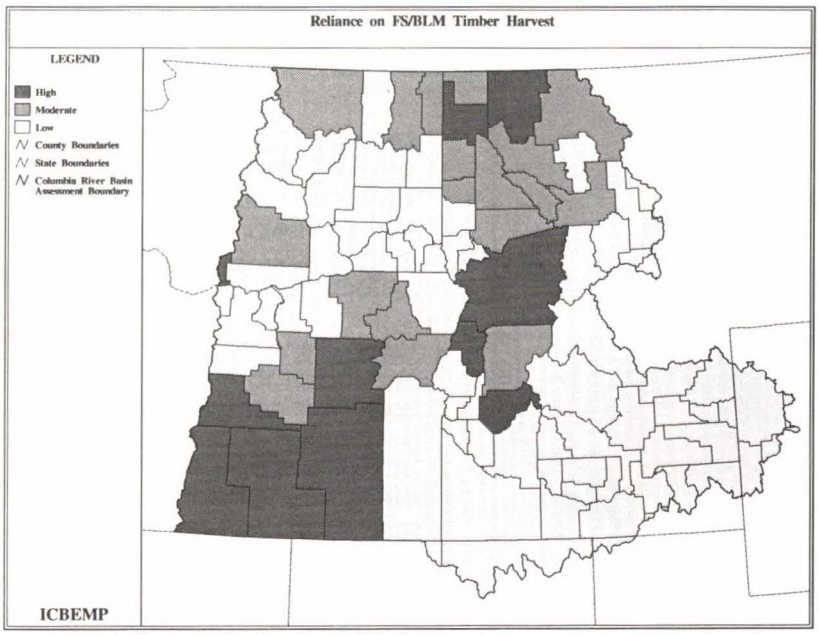


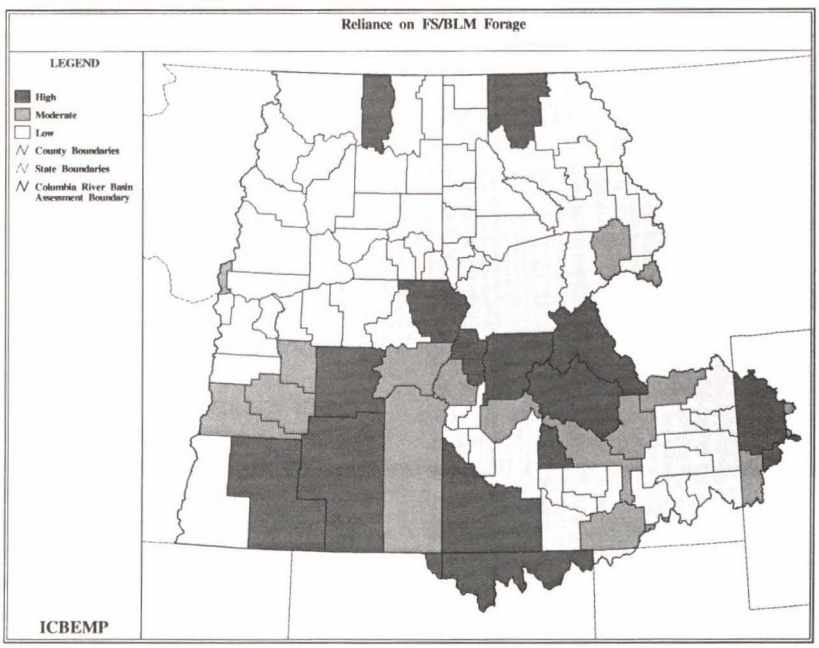
Salmonids occupy a fraction of their historic range.

Terrestrial species

Species that live in old forests, native grasslands, and native shrublands have lost habitat. The downward trends can be reversed by conserving and restoring these habitats.

Using a species-by-species approach to manage at-risk species is not likely to be successful. A broader ecosystem approach is necessary. Similarly, examining species only at the broad-scale level is not likely to conserve all species. This broad-scale analysis of the basin must be used with future analysis at the mid and fine scales.





Only 4 percent of the employment in the region comes directly from commodity production (grazing, timber, and mining). Some counties, however, are heavily reliant on Federal grazing and timber.

Socioeconomics

The regional economy of the project area is healthy, diverse, and adaptable. Natural resource production plays a relatively small role in today's regional economy: only 4 percent of the employment in the area depends directly on timber, grazing, and mining. Counties that are highly reliant on Federal lands have been identified. Some counties and communities within the basin do not have strong, robust economic conditions. Natural resource resilience differs substantially across the basin.

The management strategy

Another unique aspect of this project is the science-management partnership. Managers are already using information gathered during the scientific assessment. The information forms the basis for EISs. These documents will shape the future management of 75 million acres of Forest Service- and BLM-administered lands. Management strategies are being developed in two EISs.

Scientists do not make management decisions. They provide the information, however, that helps managers understand the risks and opportunities associated with a given management situation. In this project, the scientists and managers developed three management options. Using historic and current trends and conditions, scientists predicted the outcomes of each option. These options provided useful background information for the management alternatives explored in the EISs.

Option 1 asks the question, "What if we continued current management?"

Under this option, strategies outlined in current land management plans would continue. Scientists assumed that funding remains at recent levels, and that no interim direction (such as new riparian management directives) applies.

This management strategy emphasizes timber and livestock production while managing and protecting resources such as wildlife, fisheries, water, and scenery. In many areas, management emphasis is focused on wilderness, fisheries, or cultural resources. Management strategies are unit-specific; there is little emphasis on coordinating management strategies across Forest Service and BLM jurisdictional boundaries.

Option 2 asks the question, "What if we emphasized active restoration?"

Reducing risk to ecological integrity and species viability is the focus of this option. Management practices would aggressively restore ecosystem health by using strategies that resemble disturbance processes, such as insects, disease, and fire. The strategy is based on the premise that healthy ecosystems are better able to meet society's social and economic needs. Restoration activities are economically beneficial whenever possible. Restoration strategies cross Forest Service and BLM jurisdictional boundaries.

Option 3 asks the question, "What if we set aside a system of reserves and allowed nature to heal itself?"

All types of vegetation are included in the reserves, which are large enough to contain forest fires and other natural disturbances. Reserves consist of Forest Service- and BLM-administered lands only. Human-use levels are low. Management occurs only if disturbance events (like wildfires) are likely to end in the reserves or if management efforts are necessary to achieve long-term goals (like maintaining threatened or endangered species habitat).

Once the options were established, scientists analyzed them from the following perspectives:

Landscape ecology

Continuing current management strategies (option 1) results in higher levels of wildfire and smoke. Similarly, the reserves strategy (option 3) has a high potential for large wildfires, which generates risk for people who live near wildland areas. Option 3 has potentially high summer and fall smoke levels. Active restoration (option 2) increases smoke from prescribed fire and reduces wildfire smoke; the timing of the smoke is changed and its quantity is reduced. This option restores vegetation structure and composition closer to pre-European conditions. All options reduce the vegetation most susceptible to insects and disease. Exotic plant species continue to expand under all options. A more aggressive restoration strategy would be needed to sharply curtail exotic plant expansion.

Terrestrial ecology

A panel of scientists analyzed 173 species of potential concern. Habitat conditions for these species is less favorable now than it was historically. Option 2, which has the most beneficial results, makes only moderate habitat improvements for these species. Option 3 also results in moderate improvements. Habitat would continue to decline under option 1. None of the options approach historic conditions.

Economics

Scientists reached economics conclusions by examining all the counties within the project area. As a whole, the regional economy is healthy. Many of the counties would be relatively unaffected by the management options; however, counties that rely on timber and grazing will experience impacts. All 16 counties that are highly reliant on timber might experience negative economic impacts under options 2 and 3. Option 3, which effectively eliminates grazing from the reserves, would adversely affect 10 counties.

Social

Scientists identified five main areas of social concern:

1) Predictability in commodity outputs and outcomes from Federal lands.

2) Public access to the decisionmaking processes.

3) Primary or secondary effects that might occur on private lands.

4) Effects on communities and the quality of life.

5) Effects on American Indian tribes.

Using these criteria, people preferred option 2. For the most part, people found things they liked and disliked about every option.

Aquatic ecology

The options were measured by their ability to maintain aquatic ecosystem function, structure, and processes. Scientists rated the expected effects of an option on habitat abundance and distribution for 22 species of native fish. Option 1 will not sustain aquatic and riparian ecosystem function and structure through time. Option 3 had the most favorable outcomes. Both options 2 and 3 effectively maintain riparian areas and protect riparian functions. Option 2 has an added benefit from the manager's perspective: increased flexibility.

Managers used the three options to help them shape the seven management alternatives being analyzed in the EISs. The Science Integration Team has evaluated each alternative. The resulting evaluation of effects will aid managers during the decisionmaking process.

The publications

The science effort will generate six principal technical reports; three of which are currently available. An additional 20-30 general technical reports are also being published on specific topics related to the scientific assessment. Following is a list of the principal reports:

*Status of the Interior Columbia Basin: Summary of Scientific Findings.*General Technical Report PNW-GTR-385.

The 144-page document summarizes the approach and findings of the science assessment.

A Framework for Ecosystem Management in the Interior Columbia Basin and Portions of the Klamath and Great Basins. General Technical Report PNW-GTR-374.

This ground-floor document describes the principles and processes appropriate for ecosystem management at multiple levels. It will be especially useful initiating ecosystem management across multiple jurisdictions.

An Integrated Scientific Assessment for Ecosystem Management in the Interior Columbia Basin and Portions of the Klamath and Great Basins. General Technical Report PNW-GTR-382.

The 304-page publication documents the integration process and highlights key scientific findings.

The following documents will be available in late spring or early summer.

An Assessment of Ecosystem Components in the Interior Columbia Basin and Portions of the Klamath and Great Basins. General Technical Report (In press). Detailed social, economic, terrestrial, aquatic, and landscape ecology reports are published in this document.

Evaluation of EIS Alternatives by the Science Integration Team. General Technical Report (In press). This document and the draft environmental impact statements (EISs) will be released concurrently.

An Abbreviated Summary of Scientific Findings: Interior Columbia Basin Ecosystem Management Project (In press). About 30 pages of captioned maps will give the reader a quick overview of the science findings and their significance. The document will be released with the draft EISs.

The next steps

Filling science gaps

The scientific assessment brought information together, giving us a better understanding of the ecosystem and its conditions. It also highlighted significant gaps in our understanding. As a result, future research and development will be focused in areas including the following:

o Determine how disturbance processes such as wildfires and floods affect ecological integrity.

o Develop conservation and restoration strategies for rare aquatic and terrestrial species.

o Evaluate short and long-term relative risks of active and passive management.

o Determine how providing goods and services can be managed in concert with ecological integrity.

o Understand how rangeland integrity can be restored in concert with livestock production.

Technology transfer

A lasting legacy of this project will be its databases. The data are being shared with anyone who requests it and are already being used in other projects.

A hard look at Colorado River cutthroat trout

by Michael Young and Rick Fletcher, Rocky Mountain Station

Many populations of Colorado River cutthroat trout have been exterminated since the late 1800's. The now-familiar causes, which include introductions of non-native fishes, habitat degradation, loss and fragmentation, and overharvest, were widespread throughout the historical range of this subspecies. Most of these practices continue and presumably so does the loss of populations. An increased awareness of this loss has led to attempts to maintain and restore populations of the subspecies and to document their occurrence.

A new report from the Rocky Mountain Station, in *Conservation Assessment For Inland Cutthroat Trout* (a cooperative effort between the Rocky Mountain Station and the Northern, Intermountain and Southwestern regions of the USDA Forest Service), examines historical information on the distribution of Colorado River cutthroat trout; determines the current distribution of the subspecies in the core of its former range in Wyoming, Colorado, and Utah; and identifies characteristics that could influence the persistence of these populations.

A male Colorado River cutthroat trout.

The decline of this species has led to responses from several management agencies. The trout was classified as a Category 2 species (considered for formal listing under the Endangered Species Act until this category was abolished) by the U.S. Fish and Wildlife Service, a sensitive species by Regions 2 and 4 of the USDA Forest Service, and designated with special status by Colorado, Utah, and Wyoming. Conservation strategies have centered on surveys, angling restrictions, and channel modifications. Most conservation and management plans emphasize barrier construction to protect existing populations, or barrier construction combined with chemical treatment to prepare the waters for reintroductions.

Research Fisheries Biologist Michael Young, Rocky Mountain Station, helped lead a study to obtain information on the status and distribution of Colorado River cutthroat trout within their historical range. "First, we sent two questionnaires to state and federal biologists responsible for managing waters known or suspected to contain the species in Utah, Wyoming, and Colorado. Second, we obtained data from publications, reports, and personal contacts. Third, we searched the computerized databases maintained by the Colorado Division of Wildlife and the Wyoming Game and Fish Department for references

to Colorado River cutthroat trout and for records of stocking in waters believed to contain this subspecies."

Study results

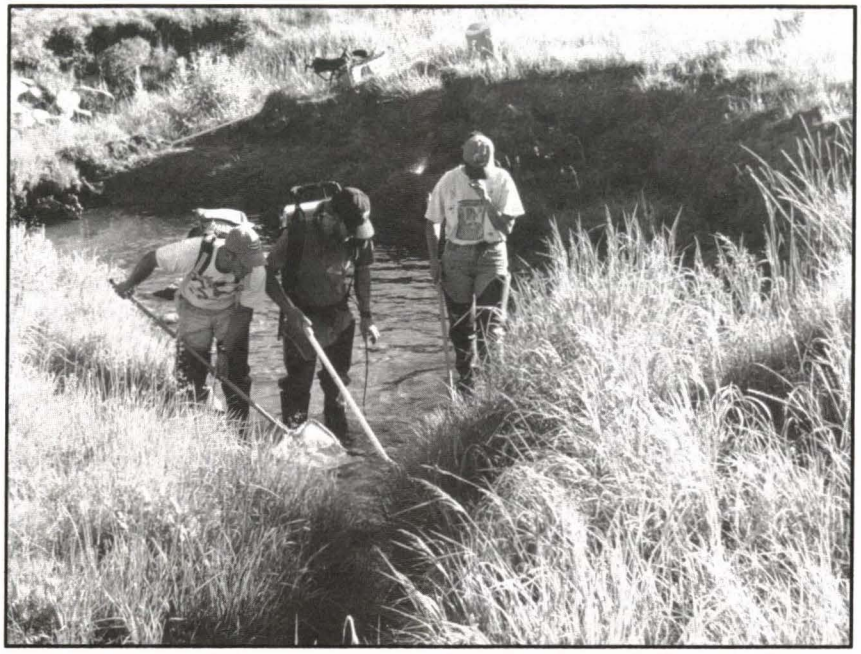
The study estimated that 318 populations of Colorado River cutthroat trout still exist within the historical range of this subspecies in Utah, Wyoming, and Colorado. Although all three states have re-established or created new populations of genetically pure trout, not all attempts to maintain or restore populations have succeeded. Populations above barriers in some streams were often not self-sustaining, but relied on repeated stocking. Inadequate or insufficient habitat may have prevented successful re-establishment, or hatchery populations may have been maladapted for restoring the species to small, fragmented streams.

Only 26 percent of the remaining populations were judged to be genetically pure. In contrast, 42 percent were thought to be introgressed with genes from rainbow trout or nonindigenous stocks of cutthroat trout.

Non-native trout

The introduction and subsequent spread of non-native trout may be the greatest threat to the continued existence of populations of Colorado River cutthroat trout. Almost 45 percent of the remaining populations at least partly co-occurred with non-native species or stocks. Brook trout occurred in nearly 90 percent of these sympatric populations and rainbow trout in 28 percent.

Stocking of non-native trout continues to threaten Colorado River cutthroat trout. Of the waters considered to support this subspecies, 30 percent had been recently stocked. Of the 152 waters believed to contain remnant populations of the species in Colorado, 70 had been directly stocked with non-native species or had presumably connected portions of the watersheds stocked. Sixty-three of the 70 waters had been stocked with species or subspecies likely to hybridize with Colorado River cutthroat trout. These stocks included rainbow trout, Pikes Peak cutthroat, Snake River fine-spotted cutthroat, Trappers Lake cutthroat, and Yellowstone cutthroat trout.



An electrofishing crew collects Colorado River cutthroat trout in south-central Wyoming.

Barriers

The majority of waters containing Colorado River cutthroat trout had not been surveyed for migration barriers. Only 28 percent of the waters with indigenous trout populations were known to have barriers that protect those populations from invasions by non-native stocks. The most insidious threats to populations of Colorado River cutthroat trout above barriers are illegal introductions by anglers. This activity often enables non-native trout to reproduce and spread before they are detected by management agencies.

A look at the future

The authors believe that, as a consequence of the introduction of non-native species, historical overharvest, improper land management, and a lack of knowledge about this subspecies, the continued existence of Colorado River cutthroat trout is in doubt. "Of the 318 waters believed to contain this subspecies, only 20 may support populations that are indigenous, genetically pure, allopatric (originating in or occupying different geographical areas) above a barrier, and in a drainage not recently stocked. Young emphasizes that the overall status of the Colorado River cutthroat trout may be much worse or only marginally better than depicted because of what is not known. More recent surveys revealed additional populations of Colorado River cutthroat trout, but no additional high-quality populations were found.

Biologists have several tactics for increasing the knowledge of the status and distribution of the subspecies. The authors recommend that biologists examine the state databases to identify waters that have not been recently stocked or sampled, or to find waters that other biologists have not noticed. "Electrofishing, or visual or hook-and-line surveys in remote waters are effective in identifying populations of Colorado River cutthroat trout, and may provide information on the characteristics, location, and permanence of natural barriers," they said. Populations protected by a natural barrier or an old human-made barrier, such as a water diversion, or those with good phenotypic characteristics are likely candidates for genetic testing. Finally, noting the location of existing populations may lead to the discovery of nearby populations and will enable biologists to recognize streams of importance to the conservation of Colorado River cutthroat trout.

For a copy of the report that details this study, write the Rocky Mountain Station and request *Status of Colorado River Cutthroat Trout*, General Technical Report RM-282.

A Sensitive Measure of Forest Ecosystem Health

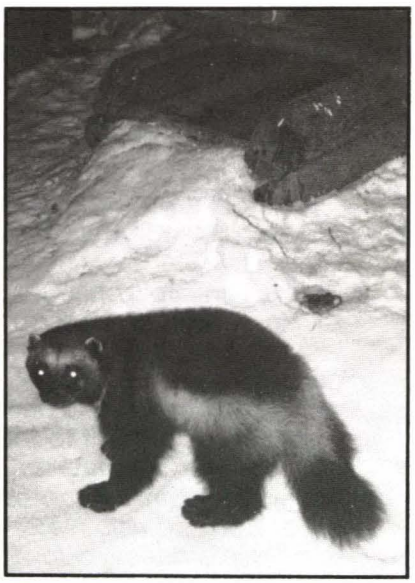
By W.J. Zielinski and Connie Gill, Pacific Southwest Station

One of the most sensitive measures of the integrity of an ecosystem is whether populations of the American marten (Martes americana), fisher (Martes pennanti), lynx (Lynx canadensis), and wolverine (Gulo gulo), occur in an area and can be sustained there. Assessing the presence of these species is an essential part of determining the health of forest ecosystems.

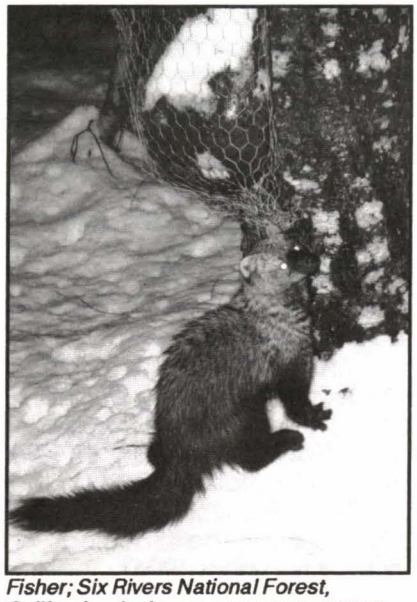
Best known for their valuable fur, martens, fishers, lynx, and wolverines (MFLW) have been trapped for commercial purposes. However, in recent years, increased public awareness of the ecological roles these animals play has highlighted the need to understand their ecology and biogeography. Now, each is receiving increased levels of administrative and legal protection, listed as "Sensitive" or as a "Management Indicator Species" as provided by the National Forest Management Act (NFMA) on most National Forests throughout its range. Because these species are protected throughout much of their range in the West, information on population status and trends is unavailable from trapping records.

Lynx; Montana; dual-sensor camera system.

These four species have similar habitat associations, can occupy the same range, often occur at low densities, have low reproductive potentials, and occupy similar niches in their communities. The effect of trapping and habitat loss may be the cause of low populations. Several investigators suspect that the accelerated harvest of old-growth forest has reduced the population of fisher and marten (Buskirk and Ruggiero 1994, Powell and Zielinski 1994). Human encroachment on the range of the wolverine is also suspected in the reducing numbers (Banci 1994). There is a growing consensus that the southern portions of these species' historic range in the western United States have recently grown smaller.



Wolverine; Sawtooth National Forest, Idaho; dual-sensor camera system.



Fisher; Six Rivers National Forest, California; single-sensor camera system.

Canada lynx prefer deep snow and used to occur in New England and the Great Lakes states. However, logging in the nineteenth and early twentieth-century probably resulted in their extinction in these areas. Now, in the western United States, Canada lynxes extend southward along the Rocky Mountains into Colorado, and occur in the north Cascades and the Okanagan Highlands of Washington (Koehler and Aubry 1994). At the more southerly latitudes, lynxes are less pronounced or absent; there are none in California.

Wolverines are known to be ferocious and like wilderness. They used to extend southward in montane boreal habitats along the Rocky Mountains as far as New Mexico, and along the Cascade-Sierra Nevada axis to the southern Sierra Nevada of California (Grinnell et al. 1937, Wilson 1982). They were extirpated from the upper Midwest in the early 1900s (deVos 1964). Now, they are rare or absent in the Great Plains and Great basin.

Marten; Sierra Nevada, California; single-sensor camera system.

Today, wolverines exist in low-density populations whose members have notoriously large home ranges. In the Rocky Mountains of Colorado and the Cascade Range and Sierra Nevada on the West Coast, the status of the wolverine is uncertain. Some sightings have been reported but there has been no photographic documentation.

Fishers occurred along the Appalachian Mountains as far south as Tennessee, and in the Midwest to southern Illinois pre-European settlement. They also ranged along the Rocky Mountains at least into Wyoming, and down the West Coast to the southern Sierra Nevada (Grinnell et al. 1937, Powell 1993, Powell and Zielinski 1994).

Fisher numbers plummeted and their range shrank drastically in the late nineteenth and early twentieth centuries. And from areas where they historically lived in the south, they are no more. In the Rocky Mountains and the West Coast, their numbers also dropped drastically. Trapping and logging were to blame; fishers were trapped easily and logging opened access for trappers.

American martens were distributed throughout Alaska and Canada. Reductions in population has been experienced in the southern and eastern parts of its range. In the Rocky Mountains the apparent patchy distribution of American martens reflects the patchy distribution of forested montane islands and is little changed from its historic pattern.

On the West Coast from Washington to California, there have been substantial reductions in the distribution of American martens, and a subspecies, the Humboldt marten may be extinct (Zielinski and Golightly 1996). American martens are relatively common in the higher elevations of the Sierra Nevada. The loss of the Humboldt marten may be due to the loss of late-successional redwood forests.

During the 1980s, concern for these species increased and stimulated several efforts by scientists and conservationists to address forest carnivores. Recently, the USFS published *The Scientific Basis for Conserving Forest Carnivores: American Marten, Fisher, Lynx, and Wolverine in the Western United States* (Ruggiero et al. 1994a). This document reviews and summarizes what is known about these animals. However, we know very little about these animals. Powell and Zielinski (1994:64) state "The primary reason for concern about the fishers in the western mountains of the United States is the utter lack of data on the ecology of the species." In the western United States, there has been only one study on wolverines, four on fishers, and five on lynx.

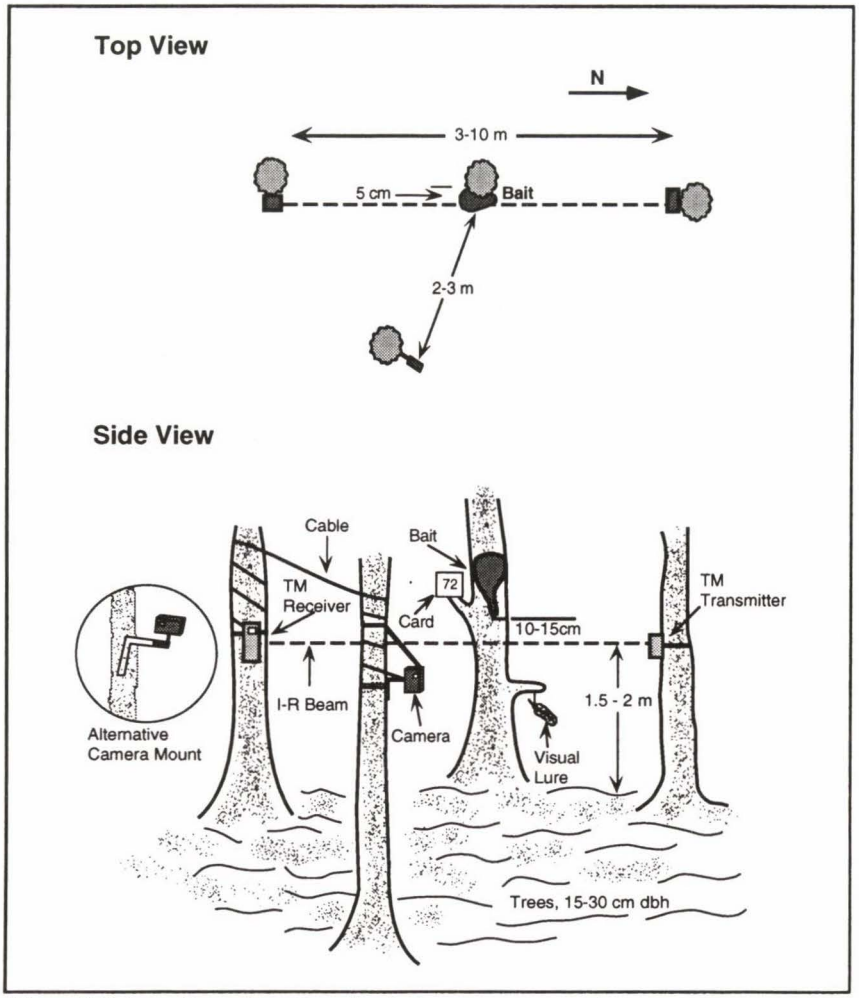
Because of the limited amount of information, the conservation status of forest carnivores is uncertain (Ruggiero et al. 1994a).

Basic reliable data of current distribution is lacking in many areas as these species are shy, inconspicuous, primarily nocturnal, occur at low densities, and are now rarely trapped in the contiguous United States. Because much of the available information dates back to 1937, it is imperative that new research be implemented to update the data that the role these species play in the forest environment may be better understood.

William Zielinski, Research Wildlife Biologist with Pacific Southwest Research Station and Thomas E. Kucera, Department of Environmental Science, Policy, and Management, University of California at Berkeley have produced a document to help resource managers detect the presence of martens, fishers, lynx, and wolverines. Zielinski's and Kucera's manual, *Lynx, Wolverines, Fishers, and Martens: Survey Methods for Their Detection* (1995), grew out of the Western Forest Carnivore Committee. The detection methods described therein can be used to produce reliable, verifiable information on the distribution of MFLW.

A land manager may wish to conduct detection surveys for one of two reasons: the first is to determine the distribution of each species within a management or administrative area. The second, is to conduct detection surveys to determine whether the target species occur in an area where some management activity is proposed.

Researchers are using standardized, non-lethal methods that allow biologists to search for MFLW in ways that will provide reasonable assurance that the species are not present if they are not detected. Three methods of detection were used: cameras (at baited stations), sooted track plates, and snow tracking. Each method offers ease of use, effectiveness and economy.



(Figure 1) Schematic configuration of a single-sensor camera station.

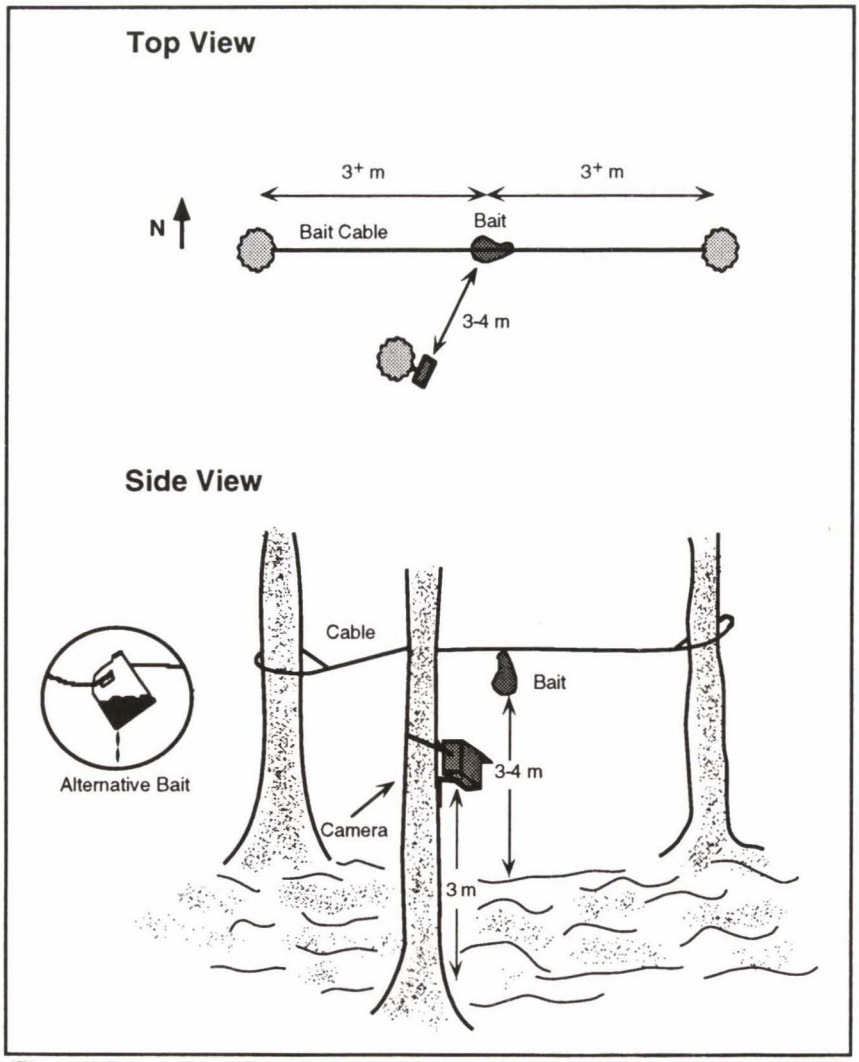
Detection Methods: camera, track plate, and snow tracking

Cameras: Two types of cameras can be set up for use in detection work: The first uses automatic 35-mm cameras and can be further divided into two types that differ by the mechanism that triggers them. These are referred to as "single sensor" and "dual sensor." The second is a line-triggered system that uses a manual, 110-size camera. Camera system type and setup is only briefly discussed here. For further information on this subject please refer to Pacific Southwest Research Station's GTR-157, *American Marten, Fisher, Lynx, and Wolverine: Survey Methods for Their Detection*, Zielinski and Kucera, 1995.

Of the first type, at least two cameras, 1.0 mile apart, are needed for each 4-mi² sample unit. More than one detection device is recommended as the distances from which target species are attracted to baits or lures at the devices are unknown, and a single station has a lower probability of detecting a target species than two devices. And, equipment can be rendered unusable because of vandalism (by humans and bears) and mechanical failure. Within the sample site, systems are set up where detections are most likely, where unconfirmed sitings have been reported or habitat suitability appears highest.

The single-sensor system is an infrared transmitter and receiver, and an automatic 35-mm camera (fig. 1). The camera is triggered when an infrared beam is broken by an animal attracted to the baited photo area.

The dual-sensor systems use automatic 35-mm cameras triggered by a microwave motion and a passive infrared heat sensor (fig. 2). The microwave sensor detects motion and the passive infrared sensor detects changes in ambient temperatures. As animals enter the photo area, the sensors are triggered



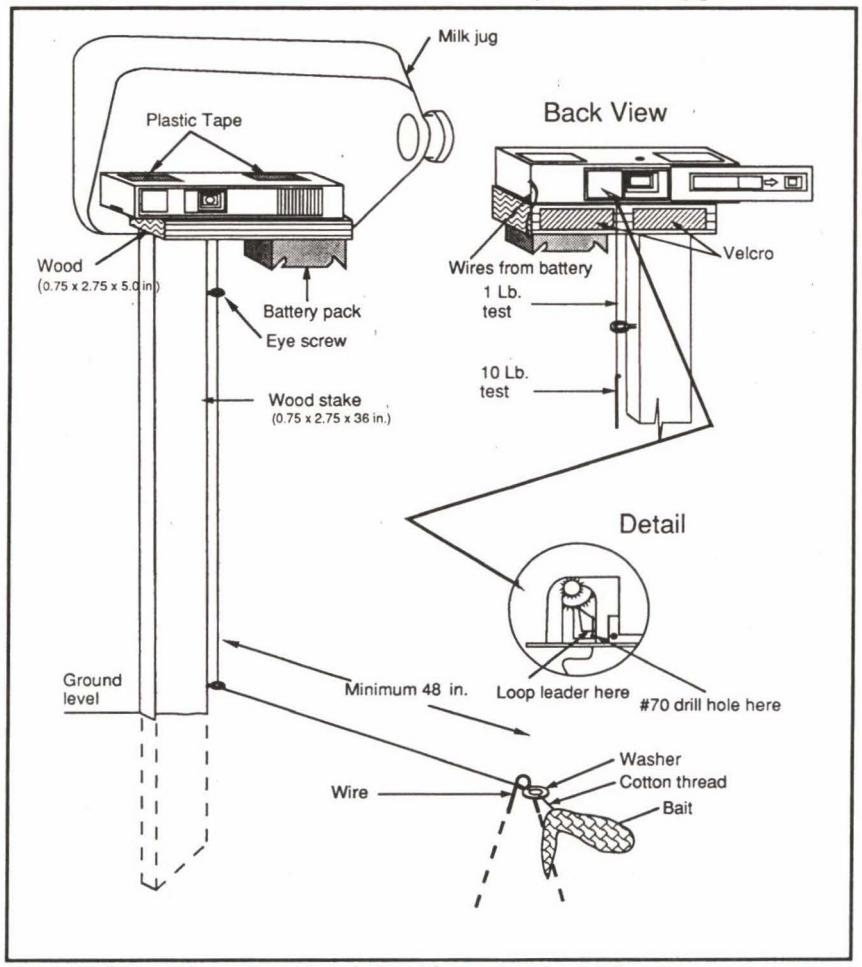
(Figure 2) Schematic configuration of a dual-sensor camera station. Meat is used as an attractant, but blood baits can also be used.

simultaneously and operate the camera. The ideal site is a sheltered, shaded area at the intersection of game trails, with three trees forming a triangle along the trail. The camera is mounted on the southern point tree at least 3.5 m from the target point, out of the reach of people and animals. To prevent animals from triggering the camera prematurely, the camera is aimed at the target point to shorten the sensor field. The two other trees support a

cable holding the bait which is at least 3 m from any tree trunk, hanging over the trail or target point, and about 3.5 m off the ground. The bait must be inaccessible as the dual-sensor camera will snap photos if a warm, moving object is in the sensor field. An animal should only be attracted to the area and leave soon because it cannot reach the bait.

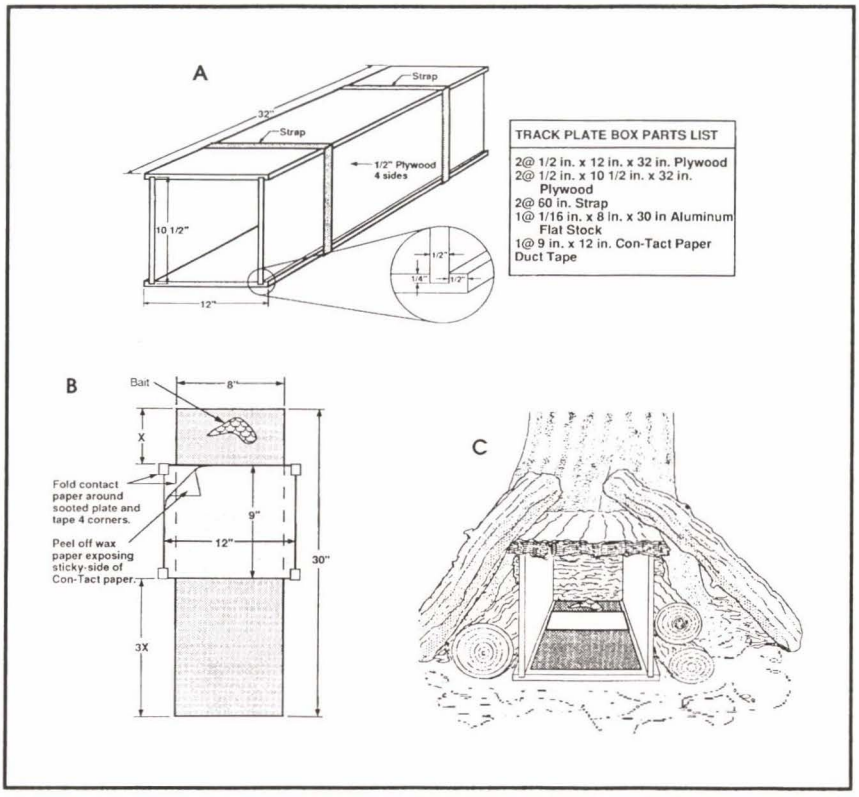
Line Trigger: The line triggered system is an inexpensive, remote triggered system using a 110-camera with an internal flash, and a minimum of six stations. The system consists of a camera mounted on a wooden post with a platform, a plastic gallon milk jug, painted dark brown or green, cut to make a protection for the camera, an external battery, and a trigger mechanism. A line from the bait directly connects with the shutter mechanism and triggers the camera (fig. 3).

Sooted Track Plates: Two sooted aluminum plate techniques are used for collecting tracks with impressions being either negatives or positives: an enclosed plate system that records tracks on white paper produces positives, and an unenclosed plate without sticky white paper produces negatives.



(Figure 3) Schematic configuration of a line-triggered camera station.

With the first method, the aluminum plate is covered by a large plywood or plastic enclosure. The first part of the plate is covered with soot. Sticky white paper is placed near the back of the box, but in front of the bait. Tracks are left on the paper as positives as the animal tries to get the bait. With the second method, the sooted aluminum plate is in the open. The animal walks across the sooted plate to the bait located near the back of the plate, tracks are left as negatives on the snow. Animal tracks are often transferred in great detail using these methods. Because there is good clarity, identifying similar species is much easier (fig. 4).



(Figure 4) Schematic drawings of a track-plate box station and its components: A) wooden plywood track box, B) sooted aluminum plate with Con-Tact paper, C) established station in field. (Based on original figure in Fowler and Golightly 1993).

Snow-Tracking Method: Snow-tracking is conducted on foot wearing snowshoes or skis, or can be done using a snowmobile. The sample unit is 4-mi^2 and all trails and roads within the unit make up the routes to be surveyed. All routes should be traveled during the course of one day, or at least, 10 km. Cover the area throughly on skis if there are no roads. Start the survey with the most likely habitat for the target species or where there have been unconfirmed sightings. There should be at least two bait sites, 1.0 mile apart, in each sample unit. The survey is terminated when the target species is detected.

Conclusion

Detection of forest carnivores can be difficult. Hopefully, the methods described by Zielinski, Kucerca and their coauthors will aid in collecting enough information to gain increased protection for MFLW. However, improving the future for these animals is dependent on new research initiatives as well. New methods and new research results will help forest managers determine ecosystem components that are necessary to sustain forest carnivores. Trying to restore species whose populations are declining is more difficult and less beneficial than planning for species conservation before the crisis happens.

"The Northern Spotted Owl provided a painful example of the consequence of delayed actions," Zielinski says. "For forest carnivores we have the opportunity to act before our actions are severely constrained by legal and political factors."

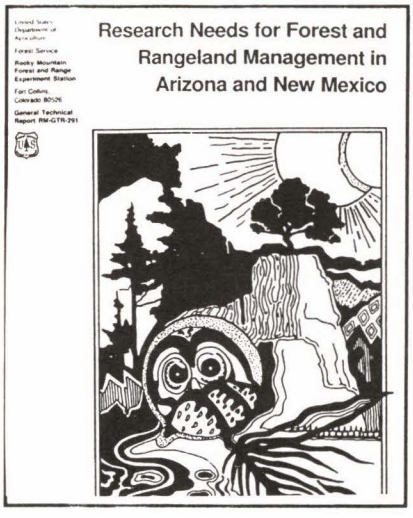
New from research

Identifying changes in tree form

Recent underestimates of total volume for timber sales in the Black Hills National Forest prompted analysis of two felled ponderosa pine data sets that were collected approximately 10 years apart. Though neither data set collected was a representative sample of the Black Hills, both were similar in terms of diameter at breast height and total height. Scientists investigated several methods for assessing differences in tree form and applied them to these two data sets. Under the assumption that these two sets were representative of harvested trees in the Black Hills, they concluded that the average tree form of harvested ponderosa pine has changed significantly in the past 10 years. This conclusion highlights the importance of using representative data in model building.

For more information on this study, write the Rocky Mountain Station and request *Identifying Changes in Tree Form for Harvested Ponderosa Pine in the Black Hills,* Research Paper RM-326. Supplies are limited.

Research needs in the Southwest



As part of a continuous process to identify research needs, a new publication provides an update of research needs for southwestern forests and rangelands. The identified needs are in four categories: 1) human needs and values; 2) wildlife habitat relationships with a threatened, endangered, and sensitive species emphasis; 3) ecosystem health, natural and human disturbances, and restoration; and 4) inventory, monitoring, and assessment. The report also contains sections on methods, current Forest Service research efforts, and additional reading. For a copy, write the Rocky Mountain Station and request *Research Needs for Forest and Rangeland Management in Arizona and New Mexico,* General Technical Report RM-291. Supplies are limited.

Response of Ponderosa Pines, Shrubs, and Grasses to Release Treatments

To release a young pine plantation on a medium site in central California, herbicides and mulches were applied soon after planting to study their effectiveness. Bearclover is an aggressive shrub species that resprouts from rhizomes after disturbance and must be controlled if young conifer seedlings are to become established. After four years, resprouting bearclover plants numbered 282,000 per acre in the control, but less than 4,000 per acre in the plots treated by herbicides. Mean foliar cover was 63 percent for the control and 1 percent for herbicide plots. Ponderosa pine seedlings were significantly taller, had larger mean diameters, and survived better in the herbicide treatment than counterparts in mulched plots and control. The 5-square-foot mulches were ineffective for controlling bearclover. Cheatgrass invaded the plantation in the second year, and after 2 more years became abundant in herbicide plots (743,667 plants per acre) and plentiful in the control (130,300 plants per acre).

Request *Response of Young Ponderosa Pines, Shrubs, and Grasses to Two Release Treatments,* Research Note PSW-RN-419, from the Pacific Southwest research Station (at its distribution center at Fort Collins, Colorado). This publication is also available on the World Wide Web through PSW's Home Page (http://www.pswfs.gov).

Development of a Mixed Shrub-Ponderosa Pine Community in a Natural and Treated Condition

On a medium site in northern California, a mostly shrub community was treated by two manual release techniques and by two herbicides, to study its development in both natural (control) and treated conditions. Survival and growth of planted ponderosa pine seedlings were quantified for 8 to 11 years after initial treatment applications. Treatments included manual release in a 4-foot radius around pine seedlings one, two, and three times; grubbing the entire one-seventh acre plot twice; applying 2, 4-D and Velpar herbicides to the entire plot once; and a control. Data are presented for the most abundant species (greenleaf manzanita), second most abundant species (snowbrush), by the two species combined, and by all 10 shrub species combined. At the end of the study in 1990, manzanita was the most abundant species with 15,267 plants per acre, cover of 24,800 ft^2, and height of 5.4 feet. Ponderosa pine developed best in plots where the entire area was grubbed twice (mean diameter at 12 inches above ground of 6.3 inches) and in the Velpar-treated plots (mean height of 14.2 feet). The cost of grubbing the entire area twice was almost $1,700 per acre. Applying Velpar, including cost of the chemical, was about $100 per acre. Site preparation without subsequent release led to a brush field similar to that present before the study began.

Request *Development of a Mixed Shrub-Ponderosa Pine Community in a Natural and Treated Condition,* Research paper PSW-RP-224, from the pacific Southwest Research Station (at its distribution center at Fort Collins, Colorado). This publication is also available on the World Wide Web through PSW's Home Page (http://www.pswfs.gov).

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1) *Status of Colorado River Cutthroat Trout*, General Technical Report RM-282.

2) *Identifying Changes in Tree Form for Harvested Ponderosa Pine in the Black Hills*, Research Paper RM-326.

3) *Analyses of the Temporal Variation of Coarse Bedload Transport and Its Grain Size Distribution*, General Technical Report RM-288.

4) *Research Needs for Forest and Rangeland Management in Arizona and New Mexico*, General Technical Report RM-291.

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3) *First Order Fire Effects Model: FOFEM 4.0, User's Guide*, General Technical Report INT-344

4) *Response of a Depleted Sagebrush Steppe Riparian System to Grazing Control and Woody Plantings*, Research Paper INT-492.

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1) *Response of Young Ponderosa Pines, Shrubs, and Grasses to Two Release Treatments*, Research Note PSW-419.

2) *Mountain Biking: Issues and Actions for USDA Forest Service Managers*, Research Paper PSW-226.

3) *Mixed Shrub-Ponderosa Pine Community in a Natural and Treated Condition*, Research Paper PSW-224.

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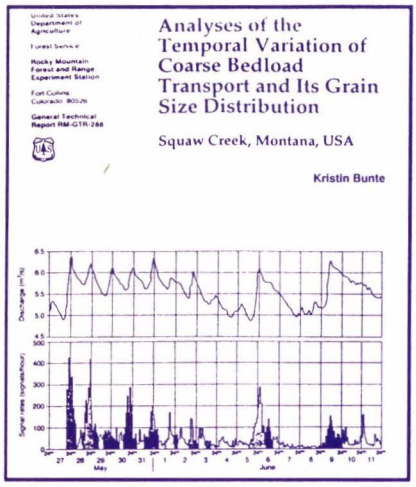
Coarse bedload transport measurements



New techniques for measuring coarse material bedload transport have been developed at Squaw Creek, a gravel-bed mountain stream in Montana. These techniques facilitated detailed investigations of the temporal variability and grain-size distribution of coarse material bedload transport and some of the parameters affecting it. The analyses presented in the report titled *Analysis of the Temporal Variation of Coarse Bedload Transport and Its Grain Size Distribution* are based on a rather large array of time series and individual measurements of various parameters measured by several techniques.

For a copy of this report, request General Technical Report RM-288, from the Rocky Mountain Station. Supplies are limited.

Mountain Biking Issues for USDA Forest Service Managers

In response to increased mountain bike riding on National forests, USDA Forest Service resource managers were surveyed to find out the volume of mountain bike riding on National Forests throughout the United States. This survey was done to determine the level of planning employed by Forest Service managers in handling bike use related issues, and to examine management issues and actions related to mountain bike use of National Forests, including resource damage, user conflicts, safety, and accidents.

Responses were received from 90 National Forests in every region of the national Forest system, and 98 percent of the responses reported mountain bike activity. Estimated use varied greatly and ranged from 50 riders to 376,000 annually.

Concerns related to mountain bike use were about the effects on natural resources (42), conflicts with other user groups (34 percent), safety (13 percent), illegal use in designated wilderness (13 percent), and growth of the sport (12 percent).

Forest managers were asked about specific problems related to mountain bike use, including reports of user conflicts, safety issues, resource damage, accidents, and management actions they had taken in responsetothese problems.

Request *Mountain Biking: Issues and Actions for USDA Forest Service Managers*, Research Paper PSW-RP-226, from the Pacific Southwest Research Station (at its distribution center at Fort Collins, Colorado). This publication is also available on the World Wide Web through PSW's Home Page (http://www.pswfs.gov).

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